

INSTRUCTION MANUAL

for

BE1-1051 OVERCURRENT PROTECTION SYSTEM

UCATM/MMS Communication Protocol



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INTRODUCTION

This manual provides detailed communications protocol information for the BE1-1051, Overcurrent Protection System with the UCA/MMS Protocol.

WARNING

TO AVOID PERSONAL INJURY OR EQUIPMENT DAMAGE, ONLY QUALIFIED PERSONNEL SHOULD PERFORM THE PROCEDURES PRESENTED IN THIS MANUAL.

CAUTION

MEGGERS AND HIGH POTENTIAL TEST EQUIPMENT SHOULD BE USED WITH EXTREME CARE. INCORRECT USE OF SUCH EQUIPMENT COULD DAMAGE COMPONENTS CONTAINED IN THE DEVICE.

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GENERAL INFORMATION

This protocol design document describes the Utility Communication Architecture (UCA) communication protocol for the BE1-1051 Overcurrent Protection Relay. The BE1-1051 relay monitors power system current, voltage, contact sensing inputs, communication ports, and the front panel HMI. The BE1-1051 provides protection, control, instrumentation, and equipment monitoring for a distribution or transmission line. The relay communications interface enables the user to monitor the status of the line at his convenience from a remote location using UCA 2 (IEC 61850) Manufacturing Message Specification (MMS)/Ethernet .

Protective Functions

The BE1-1051 Overcurrent Protection System provides protection, monitoring, control, and event recording for overcurrent systems. Control and protective functions include automatic control logic, polyphase measurement, sync-check (25), Undervoltage (27), phase-sequence voltage (47), instantaneous overcurrent (50), time overcurrent (51), overvoltage (59), voltage balance (60), reclosing (79) and frequency (81).

Communication Ports

The BE1-1051 protective relay has five communication ports. Two ports (COM0 and COM1) are RS-232 (9 pin female Dsub connectors) ports that communicate using ASCII commands. The third port (COM2) is a RS-485 (three terminal connector) multidrop differential half duplex serial port that communicates using ASCII commands, Modicon ModBus™ or DNP 3.0 (Distributed Network Protocol). Protocols are available by relay style chart selection. The fourth port, COM3, uses 10baseF multi-mode fiber optic (ST RX BNC and ST TX BNC) connectors that communicate Utility Communications Architecture (UCA) 2.0 MMS/Ethernet IEEE 802.3. The fifth port (COM4) is a style chart selectable RJ45 category 5 unshielded twisted pair (CAT5 UTP) connector or a 10baseF multi-mode fiber optic (ST RX BNC and ST TX BNC) connector that also communicates Utility Communications Architecture 2.0 MMS/Ethernet IEEE 802.3.

UCA/MMS OVERVIEW

The Utility Communications Architecture (UCA) version 2 represents a combined effort by utilities and vendors of electronic equipment to produce standardized communications systems. This UCA communication protocol document provides a description of the subset of UCA/MMS features that are supported by a BE1-1051 type relay. The following reference document files contain the complete capabilities of the UCA protocol. These reference documents are available from the UCA Users Group at <http://www.ucausersgroup.org>.

- Introduction to UCA version 2 *intro.doc*
- Generic Object Models for Substation & Feeder Equipment (GOMSFE) *gomsfe92.zip*
- Common Application Service Models (CASM) and Mapping to MMS *casm_15.doc*
- UCA Version 2 Profiles *prof_10.doc*

The user will require an MMS browser.

UCA Version 2 Profiles

UCA 2 specifies a number of profiles (communication paths) for communicating with electronic devices based on the Open Systems Interconnection (OSI) reference model. A BE1-1051 relay uses a seven layer OSI stack (TP4/CLNP profile). The TP4/CLNP profile requires the BE1-1051 relay to have a network address or Network Service Access Point (NSAP) in order to establish a communication link. The low-level physical layer ethernet uses a Media Access Control (MAC) address for accessing the physical port.

MMS Application Layer

UCA specifies the use of the Manufacturing Message Specification (MMS) at the upper (Application) layer for transfer of real-time data. This protocol has been in existence for a number of years and provides a set of services suitable for the transfer of data within a substation LAN environment. Data can be grouped

to form objects and be mapped to MMS services. MMS services include Real-Time Metering, Settings Configuration, Remote Control and Time Sync. MMS file services allow transfer of Oscillography Event Record files and Automated Reports.

Peer To Peer Communications (GOOSE)

The MMS Control service is provided by Generic Object Oriented Substation Event (GOOSE) messaging which is supported via the use of the BE1-1051 relay’s remote virtual inputs.

GOOSE Status Points

GOOSE Status Points provide a means of exchanging digital state information between network connected devices. The Goose Status Points are shared among GOOSE equipped relays. In the BE1-1051 these points are combined with BESTlogic system status variables and are made available to other devices on a common communications network. In addition to these points, GOOSE messages identify the originator of the message and other peer-to-peer report parameters. All devices listen to network messages and capture data only from devices which they have been programmed to subscribe to.

Goose Message Structure

The GOOSE message structure contains space for 96 Status Points. Each Status Point consists of a bit pair that represents digital information with four different states, TRUE, FALSE, TRANSITION and NONVALID. The UCA specification divides the 96 bit pairs into 32 “DNA” (Dynamic Network Announcement) predefined bit pairs and 64 “UserSt” (User Status) bit pairs. The BE1-1051 can be programmed to transmit up to 32 bit pairs of the possible 96 available in the GOOSE message. The BE1-1051 can be programmed to receive up to 16 bit pairs from any of the 96 bit pairs available in the GOOSE message. When the BE1-1051 transmits a GOOSE message it transmits a MULTICAST command that includes its Media Access Control (MAC) address with the two most significant hex digits set to 09. The GOOSE message contains the following information as shown in Figure 1.

- Sending IED Name (BE1-1051)
- Time Stamp of initial GOOSE message (Time)
- Phase Identification number of most recent Fault Type (PhsId)
- Media Access Control addresses of sending device (CMAC), (COM4 MAC and MULTICAST MAC)
- Maximum Hold Time (Hold)
- State Change Number (StNum)
- Sequence Number of each GOOSE message (SqNum)
- 32 Dynamic Network Announcement bit pairs (DNA)
- 64 User Status bit pairs (User)

Note: Remaining, Subscribe, Create, and History are not part of the GOOSE message.



Figure 1. GOOSE Message Format

Sending IED Name (Relay ID for Transmitting GOOSE Messages)

In a BE1-1051 relay, the Relay ID identifies the originator of the GOOSE message and can be programmed with the ASCII command SG-ID which has the format:

SG-ID[={relayID},{StationID},{UserID1},{UserID2}]

where **relayID**, **StationID**, **UserID1** and **UserID2** are ASCII text strings up to 30 characters long. The label **relayID** is used in the BE1-1051’s Goose Message to indicate the Sending IED name.

The relayID, StationID, UserID1 and UserID2 can be set using BESTCOMS with the Circuit Identification block on the Identification screen shown in Figure 2.

Remote Device ID (Relay ID for Receiving GOOSE Messages)

The receiving relay must be programmed to capture messages (Subscribe) from only those remote devices of interest. This setting is used to select specific remote devices by entering the Remote Device Identification Name and MULTICAST Media Access Control (MAC) address assigned to the selected remote device. Up to 16 remote devices identifications can be selected using the SG-RID command which has the format:

SG-RID[#={name},{MAC Addr}]

where # =1-16, **name** = ASCII text string up to 64 characters long and **MAC Addr** = string of 12 hex digits.

The 16 remote relay ID names and 16 remote relay ID MULTICAST MAC addresses can be set using BESTCOMS with the Remote Relay ID screen shown in Figure 3.

The screenshot shows the 'Identification' tab of the BESTCOMS software. It contains two main sections: 'Version Numbers' and 'Circuit Identification'. The 'Version Numbers' section includes fields for 'App Program Ver.' (set to '>= 2.00.00 6/05/02'), 'Boot Code Version', '360A Program Version', '360B Program Version', and 'Serial Number' (set to 'H00252300'). The 'Circuit Identification' section includes fields for 'Relay ID' (set to 'BE1-1051'), 'Station ID' (set to 'SUBSTATION_1'), 'General 1' (set to 'USER1_ID'), and 'General 2' (set to 'USER2_ID').

Figure 2. BESTCOMS – Identification screen

The screenshot shows the 'Remote Relay ID' tab of the BESTCOMS software. It displays a table with 16 rows, each representing a remote relay ID. The columns are 'ID #', 'Name', and 'MAC Address'. The 'Name' column contains test client names (e.g., TESTCLIENT10UT) and a zero. The 'MAC Address' column contains corresponding MAC addresses (e.g., 090012340001). A note at the bottom states: 'Name Entry must match the Relay ID in the Remote Device.'

ID #	Name	MAC Address
1	TESTCLIENT10UT	090012340001
2	TESTCLIENT10UT	090012340001
3	TESTCLIENT30UT	090012340003
4	TESTCLIENT40UT	090012340004
5	TESTCLIENT50UT	090012340005
6	TESTCLIENT60UT	090012340006
7	TESTCLIENT70UT	090012340007
8	0	000000000000

Figure 3. BESTCOMS – Remote Relay ID screen

Remote Virtual Inputs

The BE1-1051 can combine up to 16 DNA or UserSt Status Points from other I.E.D.s on the substation LAN with the BE1-1051's internal System Status logic variables. The 16 remote DNA/UserSt points are mapped to the BE1-1051's 16 internal virtual inputs defined with the ASCII command SG-VIN# which has the format:

SG-VIN#[#={ID number},{Bit Pair},{Default Value},{True Value}]

where # = 1-16, **IDNumber** = 1 – 16 , **BitPair** = 1 – 96, **Default Value** = 0,1,2 or 3 and **True Value** = 0,1, 2 or 3.

The <**IDNumber**> parameter is used to select the Remote Device whose name and address is defined with the SG-RID command. The <**BitPair**> parameter is used to select one of the possible 96 specific bit pairs in the GOOSE message. The <**Default Value**> parameter is used to select the logic state that will be used for the bit pair if the remote relay times out or is declared to be non-communicating. The <**True Value**> is the state used to indicate a TRUE condition exists from the bit pair.

The 16 remote virtual inputs can be set using BESTCOMS with the Remote Input Selection screen shown in Figure 4.

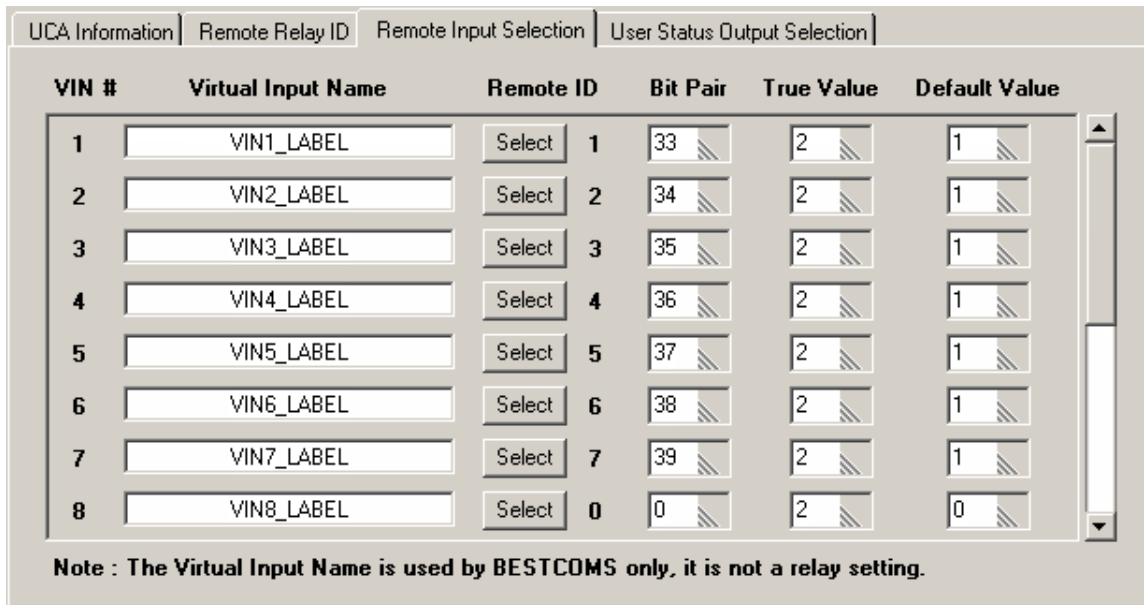


Figure 4. BESTCOMS – Remote Input Selection screen

GOOSE Status Bit Pairs

GOOSE Status Bit Pairs provide the logic state of a specific signal from a specific remote device on the substation network. 96 bit pairs (32 DNA and 64 UserSt bit pairs) are extracted from GOOSE messages originating in the remote devices to be combined with the receiving relay's internal logic. The BE1-1051 relay transmits up to 32 bit pair status points of the possible 96 points available. The predefined DNA bit pair definitions are defined in the DNA ASSIGNMENTS Table 1. The remote DNA and UserSt points definitions are defined independently by each I.E.D. on the substation LAN. The BE1-1051 DNA and UserSt points are defined with the ASCII command SG-USERST# which has the format:

SG-USERST#[#={Logic Variable},{True Value},{False Value},{Bit Pair Num}]

where # = 1 to 32 , **Logic Variable** is one of the possible 128 BEST-Logic System Status variables, **True Value** = 0,1,2 or 3, **False Value** = 0,1,2 or 3, **Bit Pair Num** = 1 to 96. Bit Pair number 1 to 32 are the DNA (Dynamic Network Announcement) bit pairs and Bit Pair numbers 33 to 96 are the UserSt bit pairs. The BE1-1051 does not make any distinction between DNA and UserSt bit pairs.

The 32 DNA and UserSt bit pairs can be programmed using BESTCOMS with the Remote Relay ID screen shown in Figure 5.

User Status #	Variable Name	True Value	False Value	Bit Pair
1	Select 101SC	2	1	1
2	Select 43	2	1	2
3	Select 143	2	1	3
4	Select 243	2	1	4
5	Select 343	2	1	5
6	Select 443	2	1	6
7	Select IN1	3	1	7

Goose Message Hold Time: ms 10000

Figure 5. BESTCOMS – User Status Output Selection

Dynamic Network Announcement (DNA) Status Points

DNA predefined Status Points are predefined functions inserted into 32 of the possible 96 GOOSE message status points. Table 1 is a suggested DNA assignments list. DNA1-DNA32 must be programmed into the BE1-1051 using the SG-USERST ASCII command or BESTCOMS.

Table 1. DNA Assignments

Bit Pair	Definition	Intended Function	Bit Pair Value			
			00	01	10	11
1	OperDev		Normal	Trip	Close	Invalid
2	Lock Out		Invalid	Normal	LO	Invalid
3	Initiate Reclosing	Initiate remote reclose sequence	Normal	Cancel	Auto Reclose	Invalid
4	Block Reclosing	Prevent/cancel remote reclose sequence	Normal	Cancel	Block	Invalid
5	Breaker Failure	Initiate remote breaker failure scheme	Normal	Cancel	Initiate	Invalid
6	Send Transfer Trip	Initiate remote trip operation	Normal	Cancel	Set	Invalid
7	Receive Transfer Trip	Report receipt of remote transfer trip command	Normal	Cancel	Set	Invalid
8	Send Perm	Report permissive affirmative	Normal	Cancel	Send Perm	Invalid
9	Receive Perm	Report receipt of permissive affirmative	Normal	Cancel	Receive Perm	Invalid
10	Stop Perm	Override permissive affirmative	Normal	Cancel	Stop Perm	Invalid
11	Send Block	Report block affirmative	Normal	Cancel	Send Block	Invalid
12	Receive Block	Report receipt of block affirmative	Normal	Cancel	Receive Block	Invalid
13	Stop Block	Override block affirmative	Normal	Cancel	Stop Block	Invalid
14	BkrDS	Report breaker disconnect 3-phase state	Between	Open	Closed	Invalid

15	BkrPhsADS	Report breaker disconnect phase A state	Between	Open	Closed	Invalid
16	BkrPhsBDS	Report breaker disconnect phase B state	Between	Open	Closed	Invalid
17	BkrPhsCDS	Report breaker disconnect phase C state	Between	Open	Closed	Invalid
18	DiscSwDS		Between	Open	Closed	Invalid
19	Interlock DS		Invalid	Non Interlock	Interlock	Invalid
20	LineEndOpen	Report line open at local end	Between	Open	Closed	Invalid
21	Mode	Report operating status of local GOOSE device	Test	Offline	Available	Un-healthy
22	Event		Invalid	Normal	Event	Invalid
23	Fault Present		Invalid	Clear	Present	Invalid
24	Sustained Arc	Report sustained arc	Invalid	Normal	Present	Invalid
25	Downed Conductor	Report downed conductor	Invalid	Normal	Downed	Invalid
26	Sync Closing		Normal	Cancel	Initiate	Invalid
27	Reserved					
28	Reserved					
29	Reserved					
30	Reserved					
31	Reserved					
32	Reserved					

Goose Hold Time (Time to Live)

The UCA specification includes features that deal with the loss of communication between transmitting and receiving devices. Each transmitting device will send (Publish) a GOOSE message upon a successful power-up, after a state change, or before the device's "hold time" (Time to Live) has expired if a change-of-state has not occurred. The transmitting device "hold time" is a settable parameter required by the receiving device. The BE1-1051 hold time is set with the ASCII command SG-HTIME with the format:

SG-HTIME[={Goose Hold Time(ms)}]

where Goose Hold Time(ms) = 1-60000 msec (0.001 – 60.000 seconds).

The Goose Hold Time can be set using BESTCOMS from the goose message hold time block in the user status output Selection screen shown in Figure 5.

Receiving devices are constantly monitoring the communications network for messages they require. Messages received from the remote device include the message "hold time" from that device. The receiving relay monitors the "hold time" interval from the sending device. If a message is not received after the hold time has elapsed, the remote device is declared to be non-communicating. This mechanism allows a receiving device to detect a single transmission from a remote device which is sending messages at the slowest possible rate, as set by its "hold timer" without having to use its default state for its remote inputs. If a message is received from a remote device before the "hold time" expires, all points for that device are updated to the states contained in the message and the "hold timer" is restarted.

REDUNDANT ETHERNET PORTS

The BE1-1051 relay has two style chart selectable options for ethernet port protocol configurations. These two options are:

Figure 6. BESTCOMS – UCA Information screen

Network Service Access Point (NSAP) Address

A BE1-1051 relay uses a seven layer OSI stack (TP4/CLNP profile). The TP4/CLNP profile requires the BE1-1051 relay to have a network address or Network Service Access Point (NSAP) in order to establish a communication link. This address can be set from any of the ASCII ports (COM0, COM1 or COM2) using the SG-NSAP command with the format:

SG-NSAP=<xx ... xx>

Where <xx ... xx> is 32 to 50 hex digits

Example: SG-NSAP=39840F80123456200000006F6F007001

The NSAP address can also be displayed or changed using BESTCOMS with the UCA Information screen as shown in Figure 6.

The Network Service Access Point (NSAP) address format is defined in RFC (Report For Comments) 1237 Guidelines for OSI NSAP with the following format. These guidelines may change based on the IAB (Internet Architecture Board).

<AFI><IDI><DFI><AA><Rd><Area><ID><SEL>
octets 1 2 1 3 2 2 8 1

	Description	Number of Octets
<AFI>	Authority and Format Identifier	1
<IDI>	Initial Domain Identifier	2
<DFI>	DSP Format Identifier	1
<AA>	Administrative Authority	3
<RD>	Routing Domain Identifier	2
<Area>	Area Identifier	2
<ID>	System Identifier	1 to 8
<SEL>	NSAP Selector	1

The Initial Domain Part consists of <AFI> and <IDI>. The Domain Specific Part consists of <DFI>, <ORG>, <Rsvd>, <Area>, <ID> and <SEL>.

When the value of the AFI is 39, the value of the IDI for the U.S. is 840, the three-digit numeric code for the United States under ISO3166.

An example of a NSAP address is 39 84 0F 80 12 34 56 20 00 00 00 6f 6f 00 70 01

CASM SERVICES

The UCA Common Application Service Models (CASM) are abstract definitions of common utility communications functions in field devices. Standardized mappings of these abstract services to the UCA application layer MMS communications protocol are defined so that common utility functions will be performed consistently across all field devices.

The client server model, in which the client initiates transactions that are then carried out by the server at the appropriate time is used in describing the server procedures that are invoked by the transactions. The BE1-1051 is the server in the client server model. Figure 7 details the BE1-1051 Server Model.

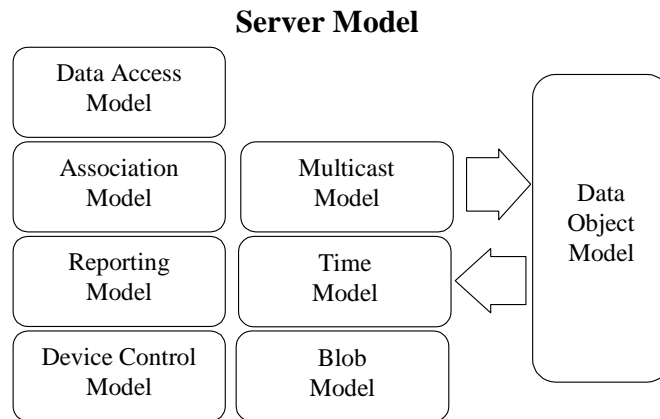


Figure 7. Server Model

The Server Model of the Common Application Service consists of the following models:

Data Access Service Model - Describes the constructs and services that must be supported by the server to allow clients to retrieve data directly and set data values at the server.

Association Model- Describes the constructs and services for establishing and relinquishing connections between a client and the server.

Reporting Service Model - Describes the constructs and services that the server must support to monitor conditions and generate reports in an on-going manner, based on parameters initially established by the client. This model includes the event, report generation and log models.

Device Control Service Model - Describes the constructs and services that must be supported by the server to allow clients to control devices connected to the Server.

Multicast Service Model -Describes the constructs and services associated with multicast operation.

Time Model- Describes the constructs and services that the server must support to allow access to and synchronization of the implementation's local time.

Blob Model - Supports the transfer of arbitrarily large data that would otherwise not fit inside a single message. Examples would include private configuration data transferred from client to server, and, transient data recordings transferred from server to client.

DataObject Model- Describes the constructs and naming conventions for the field equipment data and the special data required for the server model.

CASM Classes

Objects within a BE1-1051 server inherit the following from the CASM classes.

Logical Device - Container for objects representing device functionality, Device Models, and nameplate Device Identity.

Device Identity - Contains the information that is commonly found on a nameplate found on most equipment.

Device Model - Used to represent the idealized functional models of real devices. Device Models are assembled from a reusable set of Functional Components.

Functional Component - Acts as a framework to group common features of a device and are the major components of a Device Model. A Functional Component organizes information by purpose such as measurements (MX), configuration information (CF), status inputs(ST), or descriptions(DC).

Data Object - Used to represent the specific elements of functionality of the device. These Data Objects may be hierarchical and may be nested any number of levels.

Data Set -Used to group commonly used Data Objects for easy retrieval. A Logical Device can have zero or more Data Sets.

To represent the field device in CASM, a Logical Device contains a nameplate (Device Identity), a measurement unit (Device Model), and one or more standardized relay functions (Functional Components).

As shown in Figure 8, the RTU Server consists of one or more Logical Devices (e.g. R1234). Each Logical Device contains one Device Identity, one (typically) or more Device Models (e.g. RTU), and zero or more Data Sets (e.g. All Values). Each Device Model contains a set of Functional Components (e.g. RTU.CF, RTU.MX), which in turn contain sets of simpler Data Objects (e.g. RTU.MX.ACS1, ...), which represent the behavior of the modeled device.

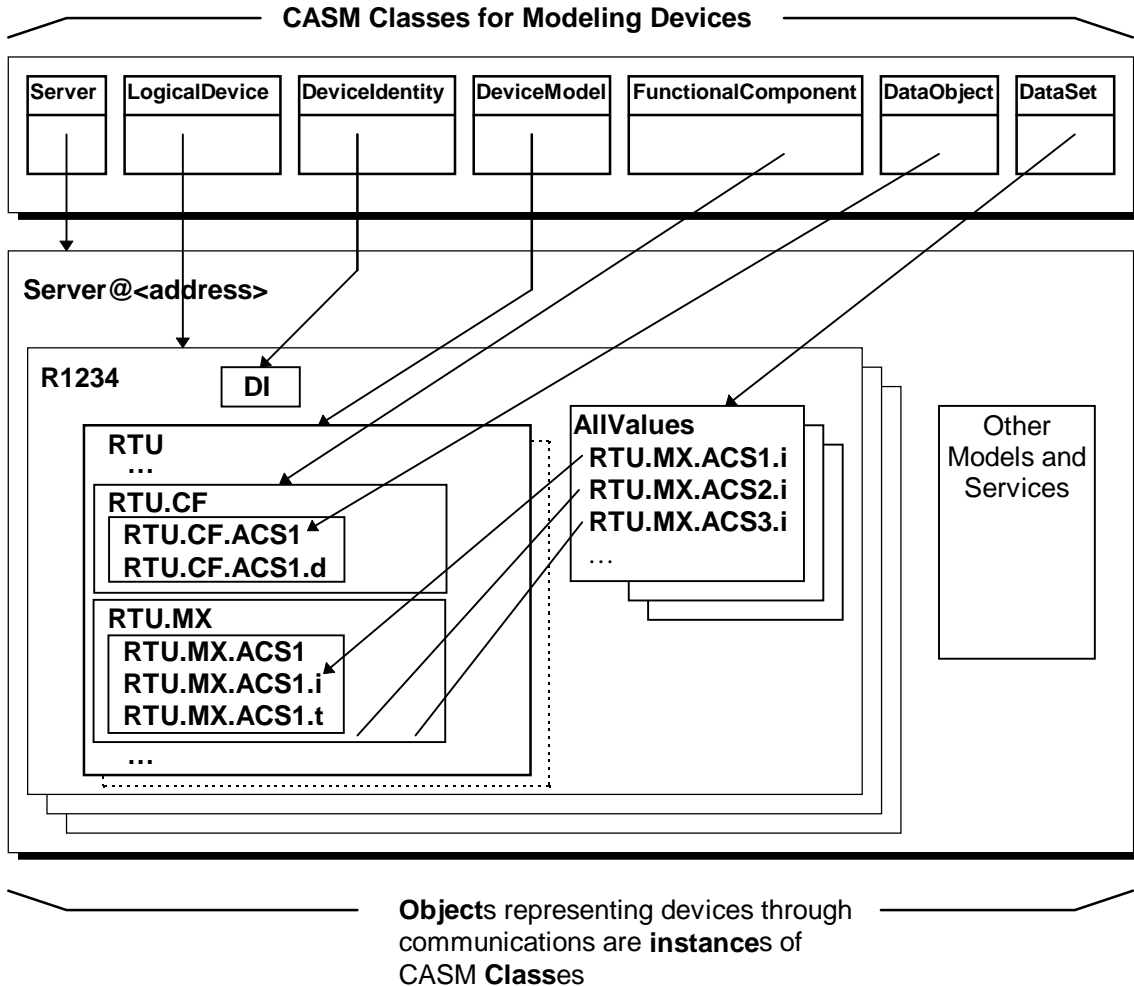


Figure 8. CASM device modeling classes and their relationship to objects

GOMSFE OBJECTS

Generic Object Models for Substation and Feeder Equipment (GOMSFE) provide self describing data object Device Models that can be seen by connecting to a BE1-1051 relay with an MMS browser such as the one shown in Figure 9.

The BE1-1051 relay supports the following GOMSFE Device Model objects:

- GLOBE (Global Attributes)
- AUTO (Automatic Control Logic)*
- MMXU (Metering quantities)
- RSYN (25-Sync Check monitoring)*
- PUVR (27-UnderVoltage protection elements)*

- PSVR (47-Phase Sequence Voltage protection elements)*
- PIOC (50-Instantaneous OverCurrent protection elements)*
- PTOC (51-Time OverCurrent protection elements)*
- POVR (59-OverVoltageTime protection elements)*
- PVCB (60-Voltage Balance protection elements)*
- RREC (79-Reclosing control)*
- PFRQ (81-Frequency Over/Under protection elements)*

* Not implemented for BE1-1051 release

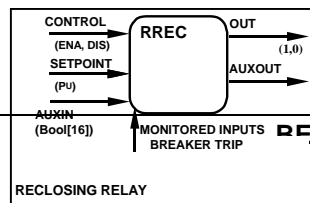
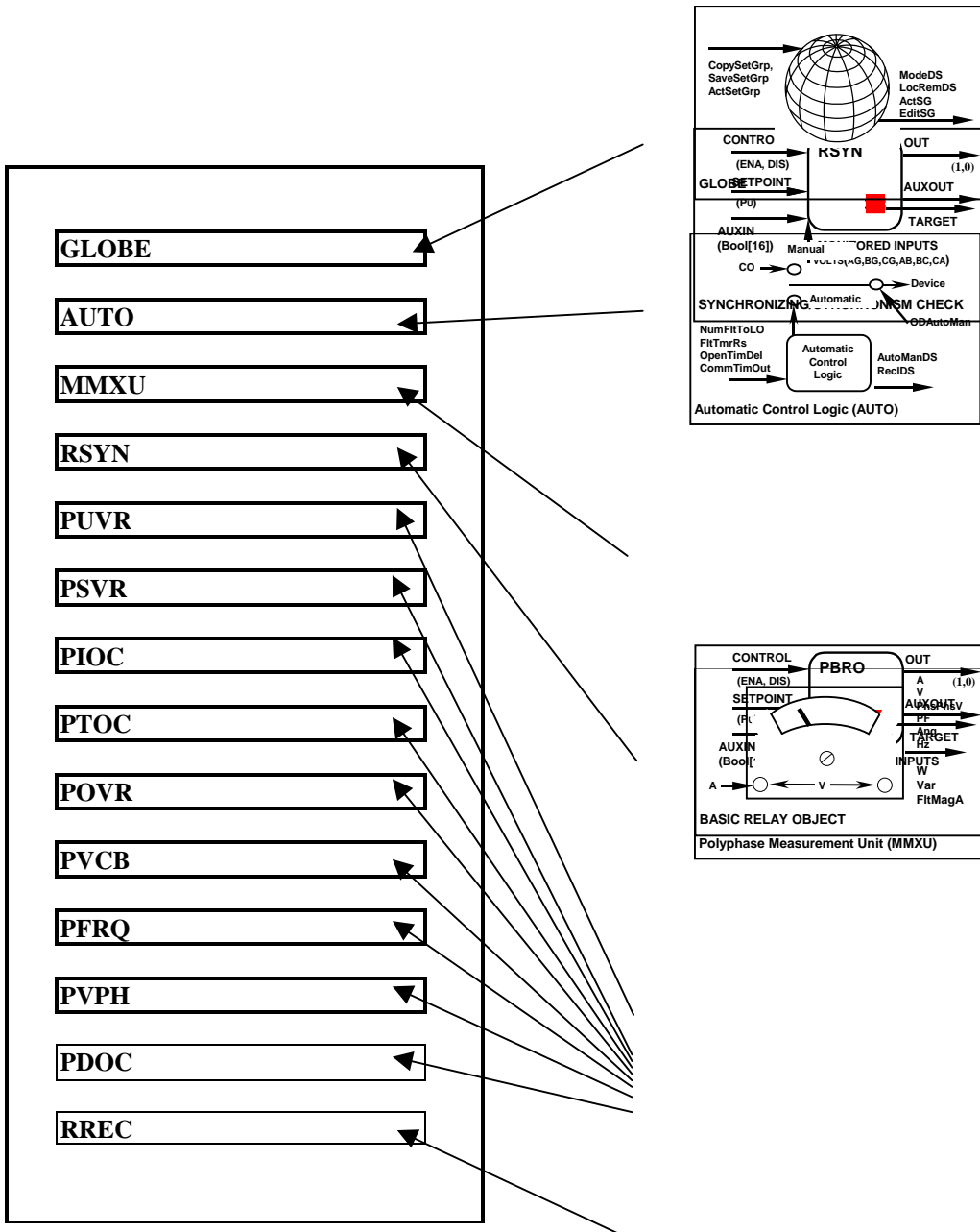
IED	Logical...	Dataset	Value
1051		DI\$Loc	SUBSTATION_1
1051		DI\$Name	1051TEST
1051		DI\$VndID\$Vnd	BASLER ELECTRIC
1051		DI\$d	BE1-1051 PROTECTION SYSTEM
1051	BE	MMXUO\$CF\$ClockTOD	08/23/2001_13:44:01.757
1051	BE	MMXUO\$MX\$V\$PhsA	11870
1051	BE	MMXUO\$MX\$V\$PhsB	11870
1051	BE	MMXUO\$MX\$V\$PhsC	11860
1051	BE	MMXUO\$MX\$V\$Neut	11890
1051	BE	MMXUO\$MX\$V\$I	08/23/2001_13:44:01.193
1051	BE	MMXUO\$MX\$A\$PhsA	189
1051	BE	MMXUO\$MX\$A\$PhsB	189
1051	BE	MMXUO\$MX\$A\$PhsC	189
1051	BE	MMXUO\$MX\$A\$Neut	188
1051	BE	MMXUO\$MX\$A\$I	08/23/2001_13:44:01.193

Figure 9. Server IED BE1-1051, Logical Device BE and Device Models DI and MMXUO

To view the available object models in the BE1-1051, the user will require an MMS browser. BASE (Basic Application Service Exposer) from KVB-Enertec Group or AX-S4MMS Object Explorer from Systems Integrations Specialist Company (SISCO) are two available MMS browsers.

BE1-1051 GOMSFE DEVICE MODEL OBJECTS

Generic Object Models for Substation and Feeder Equipment (GOMSFE) provide self describing data object Device Models that can be seen by connecting to a BE1-1051 relay with an MMS.



The BE1-1051 relay supports the following GOMSFE Device Model objects:

- GLOBE (Global Attributes)
- MMXU (Metering quantities)

The table below lists the elements not implemented in the initial BE1-1051 release.

Table 2. Elements Implemented in the BE1-1051

Element	Description
24 (PVPH)	V/Hz overexcitation for transformer backup applications. One
25 (RSYN)	Sync check with Voltage Monitor (requires optional VX input). One
27P (PUVR)	Three phase undervoltage protection with pp or pn monitoring and 1 of 3, 2 of 3, 3 of 3 logic. One
27X (PUVR)	Auxiliary undervoltage protection (line undervoltage or ground 3 rd harmonic undervoltage depending upon setup & connections). One
32, 132 (PDPR)	Forward or reverse directional power protection with two element or three element measurement depending on VT connection. Two.
43, 143, 243, 343, 443 (PBRO)	Virtual Selector Switches with tagging function. Five
47 (PSVR)	Negative Sequence overvoltage. One
50BF (PIOC)	Breaker Failure. One
50TP, 150TP, 50TN, 150TN, 50TQ, 150TQ (PIOC)	Instantaneous overcurrent with Settable Time Delay for each operating quantity (A, B, C, N (using IN or IG), Q). Two sets
51P, 51LE (PTOC)	Phase Inverse Time Overcurrent with highest phase timing, directional control, voltage restraint or voltage control and load encroachment. One
51N, 151N (PTOC)	Ground Inverse Time Overcurrent with directional control and ability to monitor IN or IG. Two
51Q (PTOC)	Negative Sequence Inverse Time Overcurrent with directional control. One
52BT	Breaker Open/Dead Line Logic
59P (POVR)	Three phase overvoltage protection with pp or pn monitoring and 1 of 3, 2 of 3, 3 of 3 logic. One
59X, 159X (POVR)	Auxiliary overvoltage protection (line overvoltage or ground overvoltage depending upon setup & connections). Two
60FL (PVCB)	VT fuse loss monitoring, One
62, 162 (PBRO)	General Purpose Logic Timers. Two
67 (PDOC)	Forward and Reverse Directional control for each overcurrent element.
79 (PREC)	Multishot recloser. One
81, 181, 281, 381, 481, 581 (PFRQ)	Over/underfrequency. Six
P85 (RCPW)	Permissive pilot tripping logic. One
86, 186 (PBRO)	Virtual lockout function with status stored to nonvolatile memory. Two
101 (PBRO)	Virtual Breaker Control Switch with tagging function. One
SOTF (PBRO)	Switch on to fault protection. One
(PBRO)	Four protection settings groups with Automatic Setting Group Selection with load, unbalance, recloser shot, or logic control.
(PBRO)	Trip Circuit Monitor

DI

Table 3. DI Object Model

GOMSFE Object	ASCII command {parameter}
DI\$Loc	SG-ID {StationID}
DI\$Name	SG-ID {relayID}
DI\$Own	SG-ID {UserID1}
DI\$VndID	
DI\$VndID\$DevMdl	
DI\$VndID\$HwRev	RG-VER App Program :
DI\$VndID\$Mdl	RG-VER Model Number :
DI\$VndID\$SerNum	RG-VER Serial Number:
DI\$VndID\$SftRev	RG-VER App Program: 360 A Program:
DI\$VndID\$Vnd	
DI\$d	

MMXU0

Table 4 MMXU0 Object Model

GOMSFE Object	ASCII command {parameter}
MMXU0\$CF\$ClockTOD	RG-TIME (msec of day) RG-DATE (days since 1/1/1984)
MMXU0\$MX\$A	
MMXU0\$MX\$A\$Neuti	M-IG magnitude in centiamps
MMXU0\$MX\$A\$PhsAi	M-IA magnitude in centiamps
MMXU0\$MX\$A\$PhsBi	M-IB magnitude in centiamps
MMXU0\$MX\$A\$PhsCi	M-IC magnitude in centiamps
MMXU0\$MX\$A\$t	
MMXU0\$MX\$Ang	
MMXU0\$MX\$Ang\$Neuti	M-IG angle in centidegrees
MMXU0\$MX\$Ang\$PhsAi	M-IA angle in centidegrees
MMXU0\$MX\$Ang\$PhsBi	M-IB angle in centidegrees
MMXU0\$MX\$Ang\$PhsCi	M-IC angle in centidegrees
MMXU0\$MX\$Ang\$t	
MMXU0\$MX\$AvgPF	
MMXU0\$MX\$AvgPF\$i	M-PF $\times 10^{-3}$
MMXU0\$MX\$AvgPF\$t	
MMXU0\$MX\$DmdA	
MMXU0\$MX\$DmdA\$Neuti	RD-PIN magnitude in CentiAmps
MMXU0\$MX\$DmdA\$PhsAi	RD-PIA magnitude in CentiAmps
MMXU0\$MX\$DmdA\$PhsBi	RD-PIB magnitude in CentiAmps
MMXU0\$MX\$DmdA\$PhsCi	RD-PIC magnitude in CentiAmps
MMXU0\$MX\$DmdA\$t	RD-PIA time stamp, msec of day, days since 1/1/1984
MMXU0\$MX\$DmdTotVAr	
MMXU0\$MX\$DmdTotVAr\$i	RD-PVAR Fwd magnitude in Vars
MMXU0\$MX\$DmdTotVAr\$t	RD-PVAR time stamp, msec of day, days since 1/1/1984
MMXU0\$MX\$DmdTotVArRvs	
MMXU0\$MX\$DmdTotVArRvs\$i	RD-PVAR Rev magnitude in Vars
MMXU0\$MX\$DmdTotVArRvs\$t	RD-PVAR time stamp, msec of day, days since 1/1/1984
MMXU0\$MX\$DmdTotW	
MMXU0\$MX\$DmdTotW\$i	RD-PWATT Fwd magnitude in Watts
MMXU0\$MX\$DmdTotW\$t	RD-PWATT time stamp, msec of day, days since 1/1/1984
MMXU0\$MX\$DmdTotWRvs	
MMXU0\$MX\$DmdTotWRvs\$i	RD-PWATT Rev magnitude in Watts
MMXU0\$MX\$DmdTotWRvs\$t	RD-PWATT time stamp, msec of day, days since 1/1/1984
MMXU0\$MX\$FltMagA	

MMXU0\$MX\$FItMagA\$Neuti	RF IN magnitude in centiamps
MMXU0\$MX\$FItMagA\$PhsAi	RF IA magnitude in centiamps
MMXU0\$MX\$FItMagA\$PhsBi	RF IB magnitude in centiamps
MMXU0\$MX\$FItMagA\$PhsCi	RF IC magnitude in centiamps
MMXU0\$MX\$FItMagA\$t	RF time stamp, msec of day, days since 1/1/1984
MMXU0\$MX\$Hz	
MMXU0\$MX\$Hz\$i	M-FREQ in centiHz
MMXU0\$MX\$Hz\$t	
MMXU0\$MX\$PPV	
MMXU0\$MX\$PPV\$PhsABi	M-VAB magnitude in centivolts
MMXU0\$MX\$PPV\$PhsBCi	M-VBC magnitude in centivolts
MMXU0\$MX\$PPV\$PhsCAi	M-VCA magnitude in centivolts
MMXU0\$MX\$SeqA	
MMXU0\$MX\$SeqA\$Negi	M-IQ magnitude in centiamps
MMXU0\$MX\$SeqA\$Zeroi	M-IN magnitude in centiamps
MMXU0\$MX\$SeqV	
MMXU0\$MX\$SeqV\$Negi	M-V2 magnitude in centivolts
MMXU0\$MX\$SeqV\$Posii	M-V1 magnitude in centivolts
MMXU0\$MX\$SeqV\$Zeroi	M-3V0 magnitude in centivolts
MMXU0\$MX\$TotVA	
MMXU0\$MX\$TotVA\$i	M-VA magnitude in VA
MMXU0\$MX\$TotVA\$t	
MMXU0\$MX\$TotVAr	
MMXU0\$MX\$TotVAr\$i	M-VAR magnitude in VARs
MMXU0\$MX\$TotVAr\$t	
MMXU0\$MX\$TotW	
MMXU0\$MX\$TotW\$i	M-WATT magnitude in Watts
MMXU0\$MX\$TotW\$t	
MMXU0\$MX\$V	
MMXU0\$MX\$V\$Neuti	M-VN magnitude in centivolts
MMXU0\$MX\$V\$PhsAi	M-VA magnitude in centivolts
MMXU0\$MX\$V\$PhsBi	M-VB magnitude in centivolts
MMXU0\$MX\$V\$PhsCi	M-VC magnitude in centivolts
MMXU0\$MX\$V\$t	
MMXU0\$MX\$VAr	
MMXU0\$MX\$VAr\$PhsAi	M-VARA magnitude in VARs
MMXU0\$MX\$VAr\$PhsBi	M-VARB magnitude in VARs
MMXU0\$MX\$VAr\$PhsCi	M-VARC magnitude in VARs
MMXU0\$MX\$VAr\$t	
MMXU0\$MX\$W	
MMXU0\$MX\$W\$PhsAi	M-WATTA magnitude in Watts
MMXU0\$MX\$W\$PhsBi	M-WATTB magnitude in Watts
MMXU0\$MX\$W\$PhsCi	M-WATTC magnitude in Watts
MMXU0\$MX\$W\$t	

PDOC0

Table 5. PDOCO Object Model

GOMSFE Object	ASCII command {parameter}
PDOC0\$RP\$GOOSE\$SendIED	
PDOC0\$RP\$GOOSE\$t	
PDOC0\$RP\$GOOSE\$SeqNum	
PDOC0\$RP\$GOOSE\$StNum	
PDOC0\$RP\$GOOSE\$HoldTim	
PDOC0\$RP\$GOOSE\$BackTim	

PDOC0\$RP\$GOOSE\$PhsID	
PDOC0\$RP\$GOOSE\$DNA	
PDOC0\$RP\$GOOSE\$UserSt	

MMS SERVICES SUPPORTED

The following MMS application services are supported by the BE1-1051 relay:

- Initiate
- Identify
- Status
- GetNames
- GetNVL
- GetDOM
- ReadVars
- WriteVars
- ReadDomains
- ReadNVLs
- Conclude
- Abort
- Time Sync
- Files
- Report Control Blocks*

* Not supported in initial BE1-1051 release

UCA Files

UCA Files supported by the BE1-1051 consist of Comtrade Oscillographic records. These records are downloaded from the relay using the MMS Files application service. The files available are configuration (*.cfg), data (*.dat), header (*.hdr) and sequence of event (*.ser).

All files are ASCII text files that may be read by any text file reader (such as Windows® Nontepad) except for the data (*.dat) files which are binary files that must be read by a Comtrade Viewer such as the Basler Electric BESTWAVE program.

Each file is named with the following format:

yyyymmddhhmmss_mmm.ext

where **yyyy** = year, **mm** = month, **dd** = day, **hh** = hour, **mm** = minute, **ss** = sec, **mmm** = msec and **ext** = cfg, dat, hdr or ser.

Example: The following event was recorded on 07/09/2002 at 11:02:40.680

20020709110240_680.cfg
 20020709110240_680.dat
 20020709110240_680.hdr
 20020709110240_680.ser

GOMSFE COMMON DATA OBJECT NAME ABBREVIATIONS

Table 6. GOMSFE Object Name Abbreviations

Abbr	Term	Abbr	Term	Abbr	Term	Abbr	Term
A	Ampere	Alm	Alarm	Ar	Arrestor	Blind	Blinder
Abbr	Abbreviation	Alw	Allowed	Arr	Array	Blk	Block, Blocking
Acc	Accumulator	Amb	Ambient	Auto	Automation	Bot	Bottom
Acs	Access	An	Analog	Avg	Average	Buf	Buffer
Act	Active	Ang	Angle	Batt	Battery	Bwid	Bandwidth
Actn	Action	App	Applications	Bctr	Bandcenter	Cal	Calculated
Adr	Address	Arc	Arcing	Bef	Before	Cap	Capacitance

Abbr	Term
Cap	Capacitor Bank
CapC	Capacitor Bank Controller
Char	Characteristic
Chg	Change
Circ	Circulating
Ckt	Circuit
CB	Circuit Breaker
Class	Class
Cld	Cold
Cls	Close
Cmd	Command
Cnd	Condition
Cns	Constraint
Cnt	Count
Coef	Coefficient
Comb	Combustible
Comm	Communications
Comp	Compensate
Con	Connected
Cond	Conductor
Conf	Confidence
Consv	Conservator
Cont	Continuous
Crv	Curve
CT	Cur Transformer
Ctl	Control
Cur	Current
Dat	Data
DC	Direct Current
Del	Delay
Den	Density
Desc	Descriptive
Dev	Device
DF	DevFct
Diel	Dielectric Strength
Diff	Difference /Differential
Dir	Directional
Dis	Disable
Disc	Discrepancy
Diss	Dissipation
Dist	Distance
Dmd	Demand
Dn	Downed
DOW	Day Of Week
DrO	Drop Out
DS	DevSt
Dsch	Discharge
Dst	Destination
Dur	Duration
Ena	Enable
Enr	Enroll

Abbr	Term
Ent	Entry
Ex	Exchanger
Evt	Event
Fact	Factor
Fail	Failure
Fct	Function
Fld	Field
Flg	Flag
Flt	Fault
Flw	Flow
Fmt	Format
FPF	Fwd Pwr Flow
Frz	Freeze
Fund	Fundamental
Fwd	Forward
Gas	Gas
Grp	Group
Ha	Harmonics
Hdw	Hardware
Hi	High
Hrs	hours
Hum	Humidity
Hyst	Hysteresis
Hz	Frequency
Id	Identity
Img	Image
In	Input
Incr	Increment
Ini	Initiate
Ins	Inside
Int	Interval
Intg	Integrity
Intlk	Interlock
Intp	Intertap
Inv	Inverse
IOC	Instantaneous Over Current
Kno	Knowledge
Lat	Latch
L	Lower
LodCtr	Load Center
Ld	Lead
LDC	Line Drop Compensation
Leak	Leakage
Len	Length
Lev	Level
Lg	Lag
Lin	Line
Lmt	limit
Lo	Low
Loc	Location
Lod	Load
Lst	List Of
M	Main

Abbr	Term
Mag	Magnitude
Maj	Major
Max	Maximum
Mdl	Model
Med	Medium (physical)
Min	Minimum
Mnr	Minor
Mot	Motor
MR	MxRef
MT	MxTyp
Mtr	Meter
Mult	Multiplier
Mx	Measurement
Na	Name
Neg	Negative
Neut	Neutral
New	Newest
Num	number
Nxt	Next
OC	Over Current
OD	OperDev
Off	Off
Ofs	Offset
Old	Oldest
On	On
Oper	Operate
Opt	Option
Optl	Optional
Ots	Outside
Out	Output
OV	Over Voltage
Ovr	Overflow
Own	Owner
Pa	Partial
PA	Preventative Autotransformer Winding
Par	Parameters
Pct	Percent
Pd	Period
PF	Power Factor
Pfd	PwrFlw Direction
Phs	Phase
Pk	Peak
Pls	Pulse
Po	Polar Coordinates
Pos	Position
Posi	Positive
PP	Phase to Phase
Pres	Pressure
Pri	Primary
Pro	Protocol

Abbr	Term
Prs	Present
Pt	Point
Pu	Pickup
Pw	Password
Pwr	Power
Qu	Quality
Quad	Quadrilateral
Quan	Quantity
R	Raise
Rat	Ratio
Rch	Reach
React	Reactive
Rec	Reclosing
Recl	Recloser
Rect	Rectangular Coordinates
Red	Reduction
Ref	Reference
Reg	Regulation (%)
Rem	Remote
Res	Resistance
Rest	Resistive
Req	Required
Rev	Revisions
Rnbk	Runback
RPF	Rvs Pwr Flow
Rpt	Report
Rs	Reset
Rsd	Residual
Rtg	Rating
Run	Running
Rvs	Reverse
Rx	Receive
SBO	Select Before Operate
Sched	Schedule
Se	Series
Sec	Secondary
Sel	Select
Seq	Sequence
Ser	Serial
Set	Set
Sft	Software
Sg	Surge
Sh	Short
Slp	Slope
Smp	Samples
Src	Source
St	Status
Start	Start
Stop	Stop
Sub	Substation
Sup	Supply
Sus	Sustained
Sw	Switch

Abbr	Term	Abbr	Term	Abbr	Term	Abbr	Term
Sync	Synchronizer	Tot	Total	Unk	Unknown	VT	Voltage Transformer
Sys	System	Trfr	Transfer	UPF	Unk Pwr Flw	W	Watt
Tag	Tag	Trg	Triggers	Use	Usage	Wav	Waveform
TDD	Total Demand Distortion	Torq	Torque	UV	Under Voltage	Wrn	Warn
Temp	Temperature	Trp	Trip	V	Volts, Voltage	Wrp	Wrap
Ter	Tertiary	Tst	Test	VA	VoltAmps	Z	Impedance
THD	Total Harmonic Distortion	Tx	Transmit	Vac	Vacuum		
Thre	Threshold	Txf	Transformer	VAr	VAr		
Tim	Time	Typ	Type	Vec	Vector		
Tmr	Timer	U	Upper	Vnd	Vendor		
		Uneq	Unequal	VR	V Regulator		
		Unit	Unit	VRed	V Reduction		

GOMSFE STANDARD DATA TYPES

Table 7. GOMSFE Standard Data Types

Name	Description	Range of Values
BOOL	Boolean - 1 bit	True (1) or False (0)
BSTR2	Bitstring - 2 bits	
BSTR8	Bitstring - 8 bits	
BSTR16	Bitstring - 16 bits	
BSTR32	Bitstring - 32 bits	
BSTRn	Bitstring – “n” bits	
INT8U	Unsigned Integer - 8 bits	0 to 255
INT16U	Unsigned Integer - 16 bits	0 to 65,535
INT32U	Unsigned Integer - 32 bits	0 to 4,294,967,295
INTnU	Unsigned Integer – “n” bits	
INT8S	Signed Integer - 8 bits	-128 to +127
INT16S	Signed Integer - 16 bits	-32,768 to + 32,767
INT32S	Signed Integer - 32 bits	-2,147,483,648 to +2,147,483,647
INTnS	Signed Integer – “n” bits	
FLT32	Floating Point, IEEE format, single precision	
FLT64	Floating Point, IEEE format, double precision	
VSTRn	Printable ASCII text string - 1 to n characters	
VSTR	Null terminated, printable ASCII text	
OSTRn	Octet String - 1 to n length	
BTIME4	Number of ms since midnight - 4 Octets	
BTIME6	Number of ms since midnight and days since 1 January 1984 - 6 Octets	
BTIME10	Number nanoseconds since milliseconds since midnight and days since 1 January 1984 - 10 Octets	
ENUM8	Enumerated value, 8 bits, signed -- Well known values positive, 0 always reserved and unused	
ENUM16	Enumerated value, 16 bits, signed – Well known values positive, 0 always reserved and unused	
IDENT	VSTR65, Identifies a Data Object or subcomponent of a Data Object within the scope of the Server	
STRUCT	Structure	
ARRAY	<TYPE>[l][j][k] ..ARRAY elements for three dimensions of TYPE	
BLOB	A reference to a Binary Large Object that can be transmitted separately in pieces rather than a single message transaction	



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